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SHORT COMMUNICATION

Bats used as hosts by *Amblyomma sculptum* (Acari: Ixodidae) in Northeastern Brazil and its implications on tick-borne diseases

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ABSTRACT. *Amblyomma* Koch, 1844 is distributed worldwide, with ca. 130 species currently recognized. These ticks are vectors of pathogens to animals and humans, including the causative agent of the New World Rocky Mountain spotted fever. Species of the *Amblyomma* parasitize a wide range of organisms, especially medium and large terrestrial mammals. Here we report for the first time the association of *Myotis lavali* Moratelli, Peracchi, Dias & Oliveira, 2011, *Noctilio albiventris* Desmarest, 1818 and *Noctilio leporinus* (Linnaeus, 1758) as hosts for *Amblyomma sculptum* Berlese, 1888. The ticks were originally identified as *Amblyomma cajennense* (Fabricius, 1787), in 2011. However, a later taxonomic review indicated that the species of the *A. cajennense* complex occurring in the Caatinga is *A. sculptum*. We also discuss the ecoepidemiological implications of this association.

KEY WORDS. Caatinga, Chiroptera, hard ticks, neotropics, parasitism.

Ticks are vectors of pathogens to humans and animals, being of public health importance (Jongejan and Uilenberg 2004). Hard ticks of *Amblyomma* Koch, 1844 are the main vectors of *Rickettsia rickettsii*, the causative agent of Rocky Mountain Spotted Fever in humans, and other bacteria that cause anaplasmosis and ehrlichiosis, among others (Sangioni et al. 2005, Schulze et al. 2005, Labruna 2009, Witter et al. 2016).

Amblyomma is one of the most common hard tick genera, with ca. 130 species, of which more than half are endemic to the New World (Guglielmone et al. 2010). *Amblyomma sculptum* Berlese, 1888, member of the *A. cajennense* complex, occurs in the central and eastern portions of South America, including northern Argentina, Bolivia, Paraguay, and Brazil (Nava et al. 2014, Martins et al. 2016). Horses and capybaras are the primary hosts for these ticks (Sangioni et al. 2005, Labruna 2009). However, *A. sculptum* also feeds on many domestic and wild terrestrial mammals (Garcia et al. 2013, Brites-Neto et al. 2015, Martins et al. 2016).

Although there are many studies reporting the association between ectoparasites and bats (e.g., Christe et al. 2003, Dick and Patterson 2006, Franck et al. 2013, Muñoz-Leal et al. 2016), bats rarely have been reported as hosts for the New World *Amblyomma* species. New findings on host/parasite interactions are crucial for the understanding of evolutionary processes of species diversification and habitat occupation, providing additional insights on the epidemiology of emerging infectious diseases. Herein we describe new records of New World bats parasitized by hard tick *A. sculptum*.

Between October 2010 and October 2012, we performed thirty nights of bat sampling in São João do Piauí (08°19'43"S; 42°21'17"W, elevation of 270 m), state of Piauí, Northeastern Brazil. The study area comprises remnants of caatinga's xerophytic vegetation, pastures and agricultural fields for cassava, maize, palm and cashew production. See Novaes et al. (2015) for a detailed description of the study site. Bat samplings were carried out using 10 ground level mist-nests (Zootech®, 9 x 3 m, 30 mm

mesh) placed in trails, natural clearings, and along riverbanks. Mist-nets were opened from six hours after dusk (ca. 6:00 pm). Bats were identified in the field, and their associated ectoparasites were collected with tweezers. Collected ticks were identified per morphological characters proposed by Barros-Battesti et al. (2006).

On October 6th, 2010, at the pond margin of an abandoned rural property, we captured an adult male of *Myotis lavali* Moratelli, Peracchi, Dias & Oliveira, 2011 (Chiroptera: Vespertilionidae) parasitized by a sub-adult of *A. sculptum*, which was adhered to the face of the bat (Fig. 1). The bat and the tick were collected and deposited in the mammal collection of Museu Nacional (MN 75191). On October 7th, 2010, at the same locality, we captured a pregnant female of *Noctilio leporinus* (Linnaeus, 1758) (Chiroptera: Noctilionidae) with a sub-adult *A. sculptum* insider the ear. The tick was removed, and the bat released in same location. On April 2, 2012, at the same locality, we captured one adult female of *Noctilio albiventris* Desmarest, 1818 parasitized by some sub-adult individuals of *A. sculptum*, together with several soft ticks *Ornithodoros* sp. (Acari: Argasidae), on the top of head, and along the dorsum, wings and uropatagium (Fig. 2). The bat and ticks were deposited in the mammal collection of Museu Nacional (MN 79943).

The hard ticks were first identified as *Amblyomma cajennense* (Fabricius, 1787) in 2011, which was the only New World species recognized at that time. However, subsequent studies split *A. cajennense* into six species (see Nava et al. 2014, Martins et al. 2016), and based on geographic location, our records correspond to *A. sculptum*. The other species in the genus in Brazil is *A. cajennense*, which is restricted to the Amazon basin (Nava et al. 2014).

These are the first records of *A. sculptum* using bats as hosts. However, there are other records of Neotropical *Myotis* and *Noctilio* being parasitized by other tick species including the congener. *Amblyomma triste* Koch, 1844, which has been recorded in *Myotis albescens* (E. Geoffroy, 1806) from Paraguay (Venzal et al. 2003), and *Ornithodoros hasei* (Schulze, 1935) (Argasidae) recorded from *N. leporinus* and that was infected with *Rickttesia* spp. in French Guiana (Tahir et al. 2016).

There are few records of *Amblyomma* ticks parasitizing bats in the world (e.g., Jones et al. 1972, Barros et al. 1998, Guerra and Serra-Freire 1999, Venzal et al. 2003, Ahamad et al. 2013, Alurralde and Díaz 2019). This might be partially explained by the bat behavior of social grooming (Carter and Leffer 2015), resulting in the removal of large sized ectoparasites. Bats were most frequently found infested by immature stages of soft ticks from family Argasidae (Franck et al. 2013, Munõz-Leal et al. 2016, Tahir et al. 2016), which are consistently smaller than those of the *Amblyomma* species. Captive observations and experiments could test this hypothesis.

Amblyomma spp. appear to not have host specificity, and the associations between ticks and their hosts seem to be more related to environmental factors than determinants inherent to the species (Nava and Guglielmone 2013). Moreover, the host preference differed between life stages, with immature ticks typically being more generalist than their adult conspecifics (Nava and Guglielmone 2013, Espinaze et al. 2015, Esser et al. 2016). As a result, in disturbed habitats without the original faunal composition, ectoparasites may infest different hosts, especially the immature ticks (McCoy et al. 2013, Esser et al. 2019, Kiene et al. 2020). Therefore, we hypothesize that the abandonment of rural property and withdrawal of livestock and domestic animals induced a new parasitic interaction between bats and *A. sculptum* by forcing the parasite to use different hosts.

The new records here reported extend the host range used by New World hard ticks from genus *Amblyomma*, which can furnish new insights about Rickettsial transmission cycle. Bats have high vagility when compared with terrestrial animals, performing seasonal migrations of thousands of kilometers and errant movements of hundreds of kilometers (Wiederholt et al.

Figures 1–2. (1) Individual of *Myotis lavali* (MN 75191) parasitized by an engorged *Amblyomma sculptum* in the xerophytic caatinga from Northeastern Brazil. Photo: Carlos Cândido. (2) Individual of *Noctilio albiventris* (MN 79943) parasitized by some sub-adult individuals of hard tick *Amblyomma sculptum* and soft tick *Ornithodoros* sp. in the xerophytic caatinga from Northeastern Brazil. Photo: Roberto Leonan M. Novaes.

2013, Arnone et al. 2016). Moreover, bats are reservoirs of *Rickttesia* spp. (D'Auria et al. 2010, Tahir et al. 2016), which makes them an important component for researches investigating pathogen dispersal and tick-borne diseases outbreaks.

There are several records of bat parasitized by hard ticks of the genus *Ixodes*, including bat species from *Myotis* restricted to the Old World (Hassan et al. 2010, Hornok et al. 2014, Burazerović et al. 2015, Frank et al. 2015). These findings reinforce the need to continue investigating relationships between bats and ectoparasites, and their implications in public health.

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